DETAILED ACTION

1. This is the initial office action for US Application No. 10/516414 titled, "Mask, Method of Producing the Same, and Method of Producing Semiconductor Device".

2. Claims 1-20 are currently pending and have been fully considered.

Drawings

3. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because reference characters "22" and "23" have both been used to designate the polysilicon layer in Figure 4. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

4. The drawings are objected to because Figure 7 appears to have a spelling error. In the ST1 box in Figure 7, the phrase "...internal sterss" should be amended to "...internal stress". Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one

figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

5. Claim 12 is objected to because of the following informalities:

The claim recites "A method of producing a mask se set forth in claim 10..." It appears that there is a typographical error between the words mask and set. Appropriate correction is required.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 1-2 and 10 are rejected under 35 U.S.C. 102(b) as being anticipated by KAWATA (US Patent 5,728,492).

The KAWATA reference recites a mask for a charged particle beam projection system. With respect to claims 1 and 10, directed to a mask and method of producing a mask comprised of a thin film, a protective film formed on the thin film, a supporting frame formed on the thin film and holes being formed in the thin film and the protective film, the KAWATA reference teaches (Column 6, Lines 44-65 and Figures 3E-3H) a mask structure having a thin film layer 12 wherein a protective film layer 14 is disposed thereon. Prior to the formation of the protective film, KAWATA also teaches (Figures 3F-3H) depositing a material 48 that is removed in locations where the supporting frame is not formed. KAWATA further teaches etching the thin film and protective film layers simultaneously to form openings according to a desired projection pattern. With respect to claim 2, directed to the use of an ion beam, KAWATA discloses (Column 1, Lines 7-10) that the mask may be used in a projection process that employs an ion beam.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

10. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over KAWATA (US Patent 5,728,492) in view of BOHLEN (US Patent 4,448,865).

The KAWATA reference does not appear to explicitly teach the limitations of claim 3 directed to a mask structure with a protective film wherein determining the thickness of the protective film is based on the energy of ion implantation. However, the BOHLEN reference recites a projection mask for ion implantation and ion beam lithography. BOHLEN teaches (Column 7, Lines 1-19) altering the thickness of a gold protective layer on the projection mask based on the ion beam energy used. BOHLEN discloses that the manner of applying the ion beam energy can further influence the thickness of the protective and thin film layers on the projection mask.

At the time of the invention, one of ordinary skill in the art would have been motivated to modify the teachings of KAWATA to further include the teachings of BOHLEN in order to achieve a desired thickness of a protective layer on a mask capable of transmitting ion beam energy onto the surface of a semiconductor substrate. As disclosed by BOHLEN (Column 2, Lines 3-12), ion beam lithography has advantages over other conventional forms of lithography because ion beams are known to exhibit negligible proximity effects during exposure. BOHLEN

also describes (Column 3, Lines 14-32) how it is advantageous to have a protective layer with a desired thickness that is capable of absorbing ions to prevent possible mask deformations. Therefore, the claim specified in the instant application would have been obvious at the time the invention was made.

11. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over KAWATA (US Patent 5,728,492) in view of AMEMIYA (US Patent 5,756,237).

The KAWATA reference does not appear to explicitly teach the limitations of claim 4 directed to a mask structure having a protective film material comprised of a photosensitive resin. However, the AMEMIYA reference recites processes for fabricating projection masks. AMEMIYA teaches (Column 9, Lines 11-16) utilizing a photosensitive resin as a protective layer during the formation a projection mask.

At the time of the invention, one of ordinary skill in the art would have been motivated to modify the teachings of KAWATA to further include the teachings of AMEMIYA in order to form a projection mask with a photosensitive protective layer. As disclosed by AMEMIYA (Column 9, Lines 11-16), several types of resins may be employed as protective layers for a projection mask. Based on the disclosure by AMEMIYA, it would have been obvious to one of ordinary skill in the art to utilize a photosensitive resin as a protective layer in order to fabricate a projection mask capable of transmitting ion beam energy onto a semiconductor substrate.

12. Claims 5-9 and 12-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over KAWATA (US Patent 5,728,492) in view of BOHLEN (US Patent 4,448,865).

With respect to claims 5 and 12-20 directed to a mask and method of forming the aforementioned mask comprised of a first thin film, a second thin film formed on the first thin film, a supporting frame formed on the first thin film and holes being formed in the first thin film and the second thin film, the KAWATA reference teaches (Column 6, Lines 44-65 and Figures 3E-3H) a mask structure having a thin film layer 12 wherein a protective film layer 14 is disposed thereon. In view of claims 12-13, 15-16 and 18, prior to the formation of the protective film, KAWATA also teaches (Figures 3F-3H) depositing a material 48 that is removed in locations where the supporting frame is not formed. KAWATA further teaches etching the thin film and protective film layers simultaneously to form openings according to a desired projection pattern. KAWATA discloses (Column 1, Lines 7-10) that the mask may be used in a lithographic projection process that employs an ion beam. KAWATA further shows (Figures 3B-3F) forming a sacrificial film on the mask substrate and subsequently removing portions of the sacrificial film to form a first set of holes. Second holes (Figure 3G) are then formed following the deposition of a protective layer.

The KAWATA reference does not appear to explicitly disclose the limitations of claims 5, 14 and 17 directed to the introduction of impurities in at least one of the first film and the second film to control an internal stress thereof. The KAWATA reference also does not appear to explicitly teach the limitations of claims 19 and 20 directed to forming semiconductor devices.

However, the BOHLEN reference recites a projection mask for ion implantation and ion beam lithography. With regard to claims 5, 14 and 17, BOHLEN teaches (Column 8, Lines 7-25) doping ions of an impurity, such as Boron, into silicon layers of a mask. BOHLEN also discloses that a material layer coating can be disposed on the aforementioned silicon layers to prevent

mask deformations based on thermal or inherent tension effects. BOHLEN further teaches (Column 7, Lines 1-19) altering the thickness of a gold protective layer on the projection mask based on the ion beam energy used. In view of claims 6-8, BOHLEN discloses that the manner of applying the ion beam energy can further influence the thickness of the protective and thin film layers on the projection mask. In view of claim 9, BOHLEN describes (Column 12, Lines 40-48) how the ion beam mask will increase in temperature upon exposure thereby reducing mechanical stability of the mask as ions are implanted in to the thin layers of the mask. In view of claims 19 and 20, BOHLEN (Column 11, Lines 50-53) indicates using the aforementioned mask in ion implantation processes or in photolithographic applications.

At the time of the invention, one of ordinary skill in the art would have been motivated to modify the teachings of KAWATA to further include the teachings of BOHLEN in order to fabricate a mask capable of transmitting ion beam energy onto the surface of a semiconductor substrate. As disclosed by BOHLEN (Column 2, Lines 3-12), ion beam lithography has advantages over other conventional forms of lithography because ion beams are known to exhibit negligible proximity effects during exposure. BOHLEN also describes (Column 3, Lines 14-32) how it is advantageous to have a protective layer with a desired thickness that is capable of absorbing ions to prevent possible temperature and stress deformations that may be incurred during exposure. BOHLEN further discloses (Column 8, Lines 7-25) how introducing a protective layer over the thin layers of a mask can prevent diffusion of the ions into the thin layers, thereby helping to prevent the aforementioned temperature and stress deformations. Therefore, the claims specified in the instant application would have been obvious at the time the invention was made.

13. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over KAWATA (US Patent 5,728,492) in view of BOHLEN (US Patent 4,448,865) as applied to claims 5-10 and 12-20 above, and further in view of AMEMIYA (US Patent 5,756,237).

The KAWATA and BOHLEN references do not appear to explicitly teach the limitations of claim 11 directed to a mask structure having a protective film material comprised of a photosensitive resin. However, the AMEMIYA reference recites processes for fabricating projection masks. AMEMIYA teaches (Column 9, Lines 11-16) utilizing a photosensitive resin as a protective layer during the formation of a projection mask.

At the time of the invention, one of ordinary skill in the art would have been motivated to modify the teachings of KAWATA and BOHLEN to further include the teachings of AMEMIYA in order to form a projection mask with a photosensitive protective layer. As disclosed by AMEMIYA (Column 9, Lines 11-16), several types of resins may be employed as protective layers for a projection mask. Based on the disclosure by AMEMIYA, it would have been obvious to one of ordinary skill in the art to utilize a photosensitive resin as a protective layer in order to fabricate a projection mask capable of transmitting ion beam energy onto a semiconductor substrate.

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

-YOSHIZAWA et al. (US 2003/0010749) disclose a stencil mask fabrication method.

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to STEWART A. FRASER whose telephone number is (571)270-5126. The examiner can normally be reached on Monday to Thursday 6:30 am to 3:30 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark F. Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/S. A. F./
Examiner, Art Unit 1795

/Mark F. Huff/
Supervisory Patent Examiner, Art Unit 1795